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Biology of the harpactorine assassin bug, Panthous bimaculatus Distant (Hemiptera: Reduviidae) on three different diets

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Abstract

The biology of the predatory reduviid, *Panthous bimaculatus* Distant, when maintained at a temperature of 32 (±2) °C, 75±5 % relative humidity and 12 (±1) hour's photoperiod on three different diets, namely, *Corcyra cephalonica*, artificial diet and *Spodoptera litura* was investigated. The incubation period was 21.3 ± 0.86, 21.00 ± 0.00, 23.00 ± 0.00 when fed on *Corcyra cephalonica*, artificial diet and *Spodoptera litura* respectively. The duration of development for the first, second, third, fourth and fifth instars fed with *C. cephalonica* was 13.47 ± 0.44, 11.56 ± 0.34, 16.24 ± 0.77, 15.24 ± 0.96 and 18.57 ± 2.53. With artificial diet, the readings were 15.76 ± 1.36, 17.00 ± 3.27, 24.25 ± 5.08, 15.00 ± 0.00 and 17.20 ± 1.57. The developmental time with regard to the feed *S. litura* was 13.67 ± 0.55, 11.97 ± 0.60, 15.86 ± 1.04, 15.36 ± 1.47 and 16.25 ± 1.82.

Keywords: *artificial diet, biology, Corcyra cephalonica, Panthous bimaculatus, Spodoptera litura.*

Introduction

The hunter reduviid, Panthous bimaculatus Distant is a potential predator and important biological control agent of many economically important pests. Reduviids in general are predacious insects that have proven to be of agricultural importance (Ambrose, 1999). They constitute one of the largest groups of predacious insects with approximately 6,800 described species (Hwang and Weirauch, 2012). The phenomenal success of their group can be solely attributed to their readily adaptive nature to hostile environmental conditions in combination with a wide range of prey capture strategies. The extreme environments they have seen to thrive in include deserts and rainforests (Ryckman, 1954; Miller, 1959). Many of these bugs are found to occur in large numbers on crevices in tree barks, shrubs and on foliage in agro ecosystems (Readio, 1927; Miller, 1953; Louis, 1974; Ambrose, 1999; Subramaniyan and Kitherian, 2012). As stated by Ambrose et al. (1999), these voracious predators due to their polyphagous nature have the potential to serve as valuable biocontrol agents in situations where a large number of various insects are present rather than in areas which are heavily infested by a single pest species.

Their unprecedented success over the last few hundred years in every microhabitat or niche possible is primarily due to the morphological, physiological adaptations with respect to feeding in combination with their extra – oral digestion facilitated by their venomous saliva (Edwards, 1961). Hence, studies on reduviidae can throw light on pest control by natural methods and can yield a new perspective to agricultural scientists in the evolution of eco-friendly pest management technologies. For this purpose, they need to be conserved and augmented (Schaefer and Ahmad, 1987). Conservation and augmentation can be achieved only with a comprehensive and elaborate understanding of their biology. In spite of their significant role in the construction and implementation of natural methods in pest control, there is ample literature on the habitat and ecological specialization of only some species of reduviids; most other species have been untouched. Hence, this study attempts to study the biology of one such untouched

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assassin bug, Panthous bimaculatus on three different diets.

Materials and methods

Laboratory colonies of the predator P. bimaculatus were established from adult male and female insects that were collected from Marunthuvazh Malai scrub jungle (latitude 8°8'11"N 77°30'47"E) in Kanyakumari District, Tamil Nadu, South India. They were separated into three groups and reared. Each group was maintained on a different food source namely, larvae of rice meal moth Corcyra cephalonica, artificial diet and Spodoptera litura. These predatory insects were kept at a room temperature of 32 (±2) °C, 75±5 % relative humidity and 12 (±1) hour's photoperiod. The adults were placed in separate containers and were allowed to mate. The containers were carefully examined at regular intervals to record the number of eggs laid. The eggs thus laid were shifted to petri dishes (9.2 x 2.0 cm) with wet cotton swabs. The moist cotton serves to maintain optimum humidity. The cotton swabs were changed at regular time intervals. The predators were reared in the laboratory for two generations to find out the incubation period, stadial period, nymphal mortality, longevity and sex ratio.

Types of Diets

Corcyra cephalonica also called rice meal moth larvae was reared in the laboratory. 2 kg of wheat flour, 250 grams of coarsely powdered groundnut, a pinch of streptomycin, 10 grams of yeast crystals, and 2 cc of Corcyra cephalonica eggs obtained from Sun Agro Biosystem Pvt Ltd, Porur were mixed well and the mixture was left undisturbed for 60 days after which the grown larva were collected to be used as feed for Panthous bimaculatus.

For the preparation of artificial diet, 200 gram beef liver extract, 200 gram fatty ground beef, 24 ml sucrose solution (5%), 1 gram ascorbic acid, 2 gram Wesson's salt mixture, 20 gram fresh egg yolk. All the ingredients were first blended with a kitchen blender until uniformly mixed. The liquid mixture was used fresh or deep frozen in small containers (De Clercq and Degheele, 1992). Cotton balls dipped in the liquid mixture were offered to the predator.

Spodoptera litura, are serious agricultural pest were collected from groundnut plantations in Kanyakumari District to be used as feed for the reduviid predator.

Biology

The Panthous bimaculatus laid pale yellow eggs singly, scattered and at times in batches, just like those of Sphedanolestes variabilis (Ambrose et al., 2009) approximately after 21.3 ± 0.86 days, 21.00 days and 23.00 days when fed on Corcyra cephalonica, artificial diet and Spodoptera litura respectively. The incubation period was much greater than that of Rhynocoris marginatus (6.81±0.10 days) (Sahayaraj and Paulraj, 2001) and Sinea complexa (15.5 days) (Swadener and Yonke, 1973) but same as that of Sycanus reclinatus (22 days) (Vennison and Ambrose, 1992). The eggs were pale yellow at the time of laying. After a couple of hours the fertilized eggs acquired a darker shade of brownish yellow. After 5 to 6 days, the fertilized eggs became brownish yellow. After almost 13 days, they turned slightly reddish with the presence of a red chorion and a few days before hatching they donned a bright red color. The hatch percentage was 100. The newly hatched nymphs were delicate and fragile and their color darkened 8 to 10 hours after hatching. It was also noticed that the new hatchlings preferred small and sluggish prey.

The newly emerged hatch outs which were pale amber in colour acquired a darker shade within a few hours of hatching. This colour change in nymphs just after hatching is also observed in Sycanus reclinatus, where the nymphs change from pale-ochraceous to dark-ochraceous a few hours after hatching (Vennison and Ambrose, 1992).

Ambrose (1999), has recorded the preoviposition period of Rhynocoris marginatus at 33.30 days, R. kumarii at 26 days, R. longifrons at 11.80 days, Ectrichodinae at 7.0 days, Salyavatinae at 6.7 days, Stenopodainae at 14.3 days, Triatominae at 14.83 days, Reduviinae at 30.4 ± 14.71 days and Peiratinae at 16.86 ± 4.36 days. The preoviposition period of Panthous bimaculatus at 12.3 days falls closer to Rhynocoris longifrons, followed by

Results:

Table 1: Incubation period, nymphal developmental time (days), sex ratio of P. bimaculatus reared on Corcyra cephalonica

Name of the predator		Panthous bimaculatus
Reared on		Corcyra cephalonica
Incubation period		21.3±0.86
Stadial period	I	13.47 ± 0.44
	II	11.56 ± 0.34
	III	16.24 ± 0.77
	IV	15.24 ± 0.96
	V	18.57 ± 2.53
Adult		69.00 ± 9.45
Sex Ratio		1:0.71

Table 2: Survival rate in % of P. bimaculatus, reared on Corcyra cephalonica

Name of the predator		Panthous bimaculatus
Reared on		Corcyra cephalonica
Hatchability		100
Nymphal survival	I	85.71
	II	78.57
	III	60.71
	IV	44.64
	V	12.5
Total		12.00

Table 3: Incubation period, nymphal developmental time (days), sex ratio of P. bimaculatus reared on artificial diet

Name of the predator		Panthous bimaculatus
Reared on		Artificial diet
Incubation period		21.00 ± 0.00
Stadial period	I	15.76 ± 1.36
	II	17.00 ± 3.27
	III	24.25 ± 5.08
	IV	15.00 ± 0.00
	V	17.20 ± 1.57
Adult		67.00 ± 2.43
Sex Ratio		1:0.65

Table 4: Survival rate in % of P. bimaculatus, reared on artificial diet

Name of the predator		Panthous bimaculatus
Reared on		Artificial diet
Hatchability		100
Nymphal survival	I	70.00
	II	53.33
	III	42.36
	IV	23.33
	V	16.36
Total		16.03

Table 5: Incubation period, nymphal developmental time (days), sex ratio of P. bimaculatus reared on Spodoptera litura

Name of the predator		Panthous bimaculatus
Reared on		Spodoptera litura
Incubation period		23.00 ± 0.00
Stadial period	I	13.67 ± 0.55
	II	11.97 ± 0.60
	III	15.86 ± 1.04
	IV	15.36 ± 1.47
	V	16.25 ± 1.82
Adult		68.88 ± 2.97
Sex Ratio		1:0.55

Table 6: Survival rate in % of P. bimaculatus, reared on Spodoptera litura

Name of the predator		*Panthous bimaculatus*
Reared on		*Spodoptera litura*
Hatchability		100
Nymphal survival	I	78.00
	II	60.00
	III	44.00
	IV	22.00
	V	15.30
Total		15.00

Stenopodainae and Triatominae.

The sex ratio observed in lab bred P. bimaculatus on the three different diets were 1:0.71, 1:0.65 and 1:0.55 respectively. However, it is interesting to note that an unbiased sex ratio was seen in laboratory reared reduviid bugs such as, Coranus siva and Brassivola hystrix (Ambrose, 1999) and was favourably biased towards the males in Sycanus reclinatus (Vennison and Ambrose, 1992).

The stadial durations of the I, II, III, IV, V instars fed on Corcyra cephalonica were 13.47 ± 0.44, 11.56 ± 0.34, 16.24 ± 0.77, 15.24 ± 0.96 and 18.57 ± 2.53 respectively (Table 1). The total stadial period from egg to adult was 75.08 with the fifth larval stage being the longest. The time needed to complete the development of one generation was 144 ± 9.45 days. The survival rates of I, II, III, IV, V instars of the predator are 85.71%, 78.57%, 60.71%, 44.64% and 12.5% respectively. The overall survival rate is 12.00% (Table 2).

The stadial durations of the I, II, III, IV, V instars fed on artificial diet were 15.76 ± 1.36, 17.00 ± 3.27, 24.25 ± 5.08, 15.00 ± 0.01 and 17.02 ± 2.56 respectively (Table 3). The total stadial period from egg to adult was 89.03 with the third larval stage being the longest. The time needed to complete the development of one generation was 155.45 ± 3.85 days. The survival rate of the I, II, III, IV, V instars of the predator are 70.00%, 53.33%, 42.36%, 23.33% and 16.36% respectively. The overall survival rate is 16.03% (Table 4).

The stadial durations of the I, II, III, IV, V instars fed on Spodoptera litura were 13.67 ± 0.55, 11.97 ± 0.60, 15.86 ± 1.04, 15.36 ± 1.47 and 16.25 ± 1.82 respectively (Table 5). The total stadial period from egg to adult was 73.11 with the fifth larval stage being the longest. The time needed to complete the development of one generation was 141.99 ± 4.45 days. The survival rate of the first, second, third, fourth and fifth instars of the predator are 78%, 60%, 44%, 22% and 15.30% respectively. The overall survival rate is 15% (Table 6).

The incubation period was minimum in the predatory reduviid, Panthous bimaculatus that were fed on artificial diet. This could ensure a faster process of multiplication of the predators. Moreover, the insects fed on artificial diet were found to be more active and energetic. This could possibly be because the energy spent in capturing the prey, in this case, the cotton ball dipped in artificial diet, is nil and the predator doesn’t have to struggle to subdue the prey with its venomous saliva before it can feed on it. At the same time, there is a slight possibility that a predator which has been fed only by artificial diet, when released into the field may not be as effective as the ones fed with other smaller insects, since it has limited experience in killing and pinning down the prey with its venomous saliva. This claim is yet to be tested and confirmed. From the study it can be concluded that the predator thrives well on artificial diet in comparison to Corcyra cephalonica and Spodoptera litura. These findings could provide an insight into the optimal conditions and feed required for the successful multiplication of these predators for dissemination in pest infested fields as a part of biological control of harmful insect pest species.

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